

Claims 1, 2, 4-6, 32-34 and 41

Claim 1 is an independent claim, with claims 2, 4-6, 32-34 and 41 depending thereon. Therefore, if claim 1 is patentable, claims 2, 4-6, 32-34 and 41 are patentable along with claim 1.

Claim 1

Claim 1 recites a reflective optical device comprising two non-axisymmetric reflection surfaces for bringing light fluxes from an object into focus on an image surface, the two non-axisymmetric reflection surfaces being a first reflection surface and a second reflection surface, wherein the first and second reflection surfaces are disposed in this order in a direction in which the light fluxes travel. Claim 1 also recites that each of the first and second reflection surfaces is a free-form surface that does not have a rotational axis.

Abel and Ohzawa do not suggest or teach these features.

Abel discloses an optical apparatus that includes reflectors 18, 20 that are arranged eccentrically (Figures 1, 3 and 4). However, the reflectors 18, 20 constitute a part of an axisymmetric paraboloid, sharing a common optical axis 22 (col. 2, lines 31-34). As a result, the reflectors 18, 20 are not non-axisymmetric as asserted in the rejection.

In addition, Abel discloses reflectors 42, 60, where the reflector 42 has an axisymmetric and aspherical surface defined by the equation $S = Dy^4 + Ey^6 + Fy^8 + Gy^{10}$ (col. 4, line 64 to col. 5, line 2), and the reflector 60 has a spherical reflection surface (col. 3, lines 57-58). As a result, the reflectors 42, 60 are not non-axisymmetric.

Further, Abel does not teach or suggest first and second reflection surfaces, each of which is a free-form surface that does not have a rotational axis.

The rejection asserts that Ohzawa discloses that the reflection lens array may be in a non-axisymmetric form. Applicants respectfully traverse.

Ohzawa discloses an illumination optical system for illuminating a surface 4 with luminous flux from a light source 30. It is not a reflective optical device for bring light fluxes from an object into focus on an image surface as claimed. Ohzawa discloses a configuration that includes two arrays 16, 26 of reflection lenses (Figure 8). Each array 16, 26 is composed of a plurality of reflection lenses (col. 7, lines 7-8 and 30-31). The luminous flux is divided into a multiplicity of luminous fluxes by the reflection arrays (col. 7, lines 19-21). As a result, the

configuration and effect of the arrays is different from the effect achieved by a reflective optical device.

Therefore, there is no suggestion or teaching for combining an illumination optical system, as taught by Ohzawa, with a reflective optical apparatus as taught by Abel. One cannot simply interchange elements in an optical system and expect the system to operate. Here, the configuration and effect of the arrays of Ohzawa, as used in an illumination optical system, are different from the configuration and effect of the reflectors in Abel as used in a reflective optical apparatus, and there is no teaching that one can be substituted for the other. Thus, the proposed combination is simply not suggested by the prior art.

Nor does Ohzawa teach or suggest first and second reflection surfaces, each of which is a free-form surface that does not have a rotational axis. Therefore, even if Abel and Ohzawa are combined, the claimed invention does not result.

For at least these reasons, claim 1 is patentable over Abel and Ohzawa. Claims 2, 4-6, 32-34, and 41 depend from claim 1 and are patentable for the reasons given for claim 1 and need not be separately distinguished. By not specifically addressing the rejection to the dependent claims, Applicants do not concede the propriety of the rejection or any statements made in the rejection.

Claims 15, 97, 99 and 102

Claim 15 is an independent claim, with claims 97, 99 and 102 depending thereon. Therefore, if claim 15 is patentable, claims 97, 99 and 102 are patentable along with claim 15.

Claim 15 recites a reflective optical device that includes a second reflection surface that is concave in a cross-sectional shape taken in the vicinity of its vertex along a plane containing vertices of the reflection surfaces, and is convex in a cross-sectional shape taken in a direction perpendicular to the plane.

Abel does not teach every element recited in claim 15. Abel discloses a reflector 60 that has a spherical shape (Fig. 2). Therefore, the reflector 60 is convex in both cross-sectional shapes in vertical and horizontal directions. The reflector 60 is not concave in a cross-sectional shape taken in the vicinity of its vertex along a plane containing vertices of the reflection surfaces and convex in a cross-sectional shape taken in a direction perpendicular to the plane, as recited in claim 15.

In addition, the reflector 42 in Abel is aspherical. Claim 15 recites the shape "taken in the vicinity of its vertex". In Figure 2 of Abel, the reflector 42 has a concave cross-sectional shape taken in the vicinity of its vertex. As noted above, the reflector 42 has an axisymmetric and aspherical surface defined by the equation $S = Dy^4 + Ey^6 + Fy^8 + Gy^{10}$ (col. 4, line 64 to col. 5, line 2). Therefore, the reflector 42 is axisymmetric, and its cross-sectional shape taken in the immediate vicinity of its vertex is concave in both the vertical and horizontal directions. The reflector 42 is not concave in a cross-sectional shape taken in the vicinity of its vertex along a plane containing vertices of the reflection surfaces and convex in a cross-sectional shape taken in a direction perpendicular to the plane, as recited in claim 15.

Further, Abel does not disclose a configuration in which the second reflection surface is concave in a cross-sectional shape taken in the vicinity of its vertex along a plane containing vertices of the reflection surfaces, and is convex in a cross-sectional shape taken in a direction perpendicular to the plane. In optical designing, in order to correct aberration and achieve excellent focusing performance, the order in which concave and convex surfaces are arranged and the curvatures imparted to the concave and convex surfaces are important elements that determine the optical performance. That is why claim 15 recites the second reflection surface as having the claimed configuration.

In Figure 2 of Abel, neither the reflector 60 nor the reflector 42 have the configuration recited in claim 15. Figure 3 of Abel shows that the reflectors 60 and 42 do not constitute the second reflection surface in the system.

For at least these reasons, claim 15 is not anticipated by Abel. Claims 97, 99 and 102 depend from claim 15 and are patentable for the reasons given for claim 15 and need not be separately distinguished. By not specifically addressing the rejection to the dependent claims, Applicants do not concede the propriety of the rejection or any statements made in the rejection.

Applicants acknowledge the indication that claims 3 and 8-10 contain allowable subject matter. As discussed above, Applicants believe that all of the examined claims are patentable as well.